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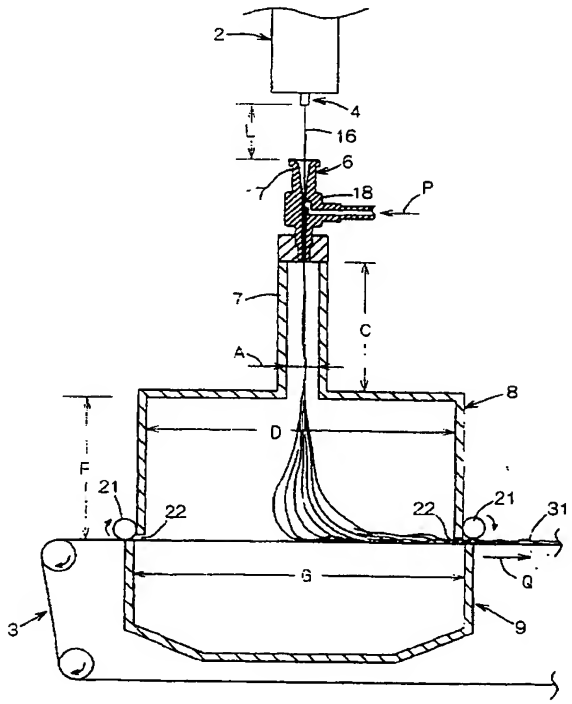
(54) Apparatus for making nonwoven fabric

(57) An apparatus 1 for making a nonwoven fabric including, between spinning nozzles 4 and a top surface of an air-permeable endless belt 3 running in one direction, air blow means 6 spaced apart from the nozzles 4, a duct 7 directly connected to the air blow means 6 and a hood 8 directly connected to the duct 7 so as to cover the vicinity of the top surface of the endless belt 3 so that the interior of the hood may be subjected to a suction effect exerted through the endless belt 3 from below the endless belt 3.

FIG.2



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Description

[0001] This invention relates to an apparatus for making a nonwoven fabric from continuous fibers.

[0002] There have already been proposed a process as well as an apparatus adapted to accumulate continuous fibers discharged from spinning nozzles of an extruder onto a top surface of an endless belt running in one direction and thereby to make a nonwoven fabric. The endless belt in the known apparatus is air-permeable and there is provided below this endless belt with a suction zone. It is well known in the known apparatus to provide an air gun or suckers serving to blow pressurized air against the continuous fibers, to provide a relatively narrow duct below the air gun or the suckers and to provide a hood below the duct so that the endless belt may be partially covered with the hood.

[0003] Provision of the duct and the hood in accordance with the prior art enables a stretching ratio for the fibers to be improved and thereby a desired nonwoven fabric to be made from the continuous fibers having a relatively small denier number. However, the fibers discharged from the spinning nozzles must be previously thinned in order to obtain the fibers having a fineness smaller than 1 d and this requirement deteriorates a production efficiency of a nonwoven fabric per unit time.

[0004] It is an object of this invention to improve the known apparatus so that the nonwoven fabric may be efficiently made from the continuous fibers of a fineness less than 1 d.

[0005] According to this invention, there is provided an apparatus for making a nonwoven fabric adapted to accumulate continuous fibers discharged from a plurality of spinning nozzles onto a top surface of an air-permeable endless belt running in one direction under a suction effect exerted from below the endless belt, wherein: between the nozzles and the endless belt, the apparatus comprises means adapted to blow pressurized air against the continuous fibers, a duct having a relatively small dimension as viewed in running direction of the endless belt and directly connected to the means so as to extend downward and a hood having a relatively large dimension as viewed in the running direction and directly connected to the duct so as to cover a vicinity of the endless belt's top surface so that an interior of the hood may be subjected to the suction effect exerted through the endless belt from below the endless belt.

[0006] Fig. 1 is a fragmentary perspective view showing an apparatus for making a nonwoven fabric;

[0007] Fig. 2 is a sectional view taken along a line II - II in Fig. 1; and

[0008] Fig. 3 is a fragmentary sectional view showing an alternative embodiment of the invention.

[0009] Details of an apparatus for making a nonwoven fabric according to this invention will be more fully understood from the description given hereunder with reference to the accompanying drawings.

[0010] Fig. 1 is a fragmentary perspective view showing an apparatus for making a nonwoven fabric 1 and Fig. 2 is a sectional view taken along a line II - II in Fig. 1. The apparatus 1 includes an extruder 2 and an array comprising a plurality of spinning nozzles 4 arranged transversely of an endless belt 3 running in a direction indicated by an arrow Q. Between the array of nozzles 4 and the endless belt 3, an air gun 6, a duct 7 and a hood 8 are connected one to another in this order so as to establish a substantially air tight condition. A box 9 underlies the hood 8 with the endless belt 3 therebetween and an exhaust duct 11 extends from the box 9 in a direction indicated by an arrow X. The exhaust duct 11 has its distal end connected to a blower (not shown).

[0011] The array of nozzles 4 each having an orifice diameter of 0.3 ~ 0.7 mm are arranged on a nozzle plate 2a of the extruder 2, which nozzle plate 2a extends transversely of the endless belt 3 having a width of 250 ~ 3000 mm. The array comprises 200 ~ 25000 zones 4 over a length of 200 ~ 25000 mm. The air gun 6 is spaced from the array of nozzles 4 by a distance L of 100 ~ 1500 mm. The duct 7 has a dimension A of 5 = 20 mm as measured in a running direction of the endless belt 3, a dimension B of 200 ~ 2500 mm as measured transversely of the endless belt 3 and a dimension C of 50 ~ 1000 mm as measured vertically of Fig. 1. The hood 8 has a dimension D of 50 ~ 1500 mm as measured in the running direction of the endless belt, a dimension E of 200 ~ 2500 mm as measured transversely of the endless belt 3 and a dimension F of 50 ~ 2000 mm as measured vertically of Fig. 1, and extends above the top surface of the endless belt 3 with a clearance 22. The box 9 has a dimension G of 50 ~ 1500 mm as measured in the running direction of the endless belt 3, a dimension H of 200 ~ 2500 mm as measured transversely of the endless belt 3 and a vertical dimension as viewed in Fig. 1 which may be optionally selected. The duct 7 is located at the middle of the hood 8 as viewed in the running direction of the endless belt 3 and the hood 8 is positioned substantially in vertical alignment with the box 9. In front and behind the endless hood 8, there are provided rollers 21. The rollers 21 function to close the clearance between the endless belt 3 and the hood 8 so that a negative pressure within the hood 8 may be maintained sufficiently high even during running of the endless belt 3. These rollers 21 are adapted to move vertically of the endless belt 3 as the rollers 21 rotate in the running direction of the endless belt 3.

[0012] The nozzles 4 continuously discharge a plurality of thermoplastic synthetic resin fibers 16 downward as viewed in figures, which are then introduced into an upper end portion 17 of the air gun 6. In the vertically middle portion 18 of the air gun 6, a flow of pressurized air supplied in a direction indicated by an arrow P and blows against the fibers 16 which are thereby accelerated downward into the duct 7. The fibers 16 pass straight through the relatively narrow duct 7 into the relatively wide hood 8 in which the fibers 16 are correspondingly decelerated. The hood 8 is vertically opposed to the box 9 having an open top with the air-permeable endless belt 3 therebetween. The box 9 is in fluid

communication with the blower so that the interior of the hood 8 is maintained at a desired level of negative pressure under a suction by the box 9. The hood 8 at the desired level of negative pressure functions to pull the fibers 16 within the duct 7 so that these fibers 16 may be directed to the hood 8. The fibers 16 which have passed straight through the relatively narrow duct 7 in parallel one to another oscillate longitudinally as well as transversely of the endless belt 3 as these fibers 16 enter the hood 8 which lies adjacent the top surface of the endless belt 3 and is enlarged in the running direction of the endless belt 3. As a result, the fibers 16 are intertwined and accumulated on the top surface of the endless belt 3. The fibers 16 accumulated on the endless belt 3 in this manner are conveyed through the clearance 22 between the endless belt 3 and the hood 8 and then between the endless belt 3 and roller 21 to be brought out from the hood 8 and to be taken up in a roll of nonwoven fabric 31. Assumed that the fibers 16 are in molten or softened state as the fibers 16 are accumulated on the endless belt 3, the fibers 16 can be bonded one to another at their contacting points. Furthermore, oscillation of the fibers 16 within the hood 8 enables them to be mechanically intertwined.

[0013] During the process for making the nonwoven fabric 31 in this manner, the fibers 16 are stretched at a high ratio in the course from the nozzles 4 to the hood 8, particularly during a period elapsing from a point at which the fibers 16 have been discharged from the nozzles 4 to a point at which the fibers 16 begin to be accelerated by the air gun 6 period starting from being discharged from the nozzles 4. Such stretching is achieved by cooperation of a pressure of air blown from the air gun 6 with a pulling force of the hood 8 sucking this air. The gun 6, the duct 7 and the hood 8 may be directly connected one to another and the clearance 22 defined between the hood 8 and the endless belt 3 may be closed by the respective rollers 21 to ensure the pulling force to act upon the fibers 16.

[0014] In order to ensure that the fibers 16 are stretched at a desired high ratio and, after having stretched, oscillate over a relatively large extent as measured longitudinally as well as transversely of the endless belt 3, A : C, a ratio of a dimension A of the duct 7 to a dimension C of the duct 7 is preferably in a range of 1 : 2.5 ~ 1 : 200, C : D, a ratio of the dimension C of the duct 7 to a dimension D of the hood 8 is preferably in a range of 1 : 1 ~ 1 : 1.5. D : F, a ratio of the dimension D of the hood to a dimension F of the hood 8 is preferably in a range of 1 : 1 ~ 1 : 1.3. A suction capacity of the box 9 is preferably in a range of 8 ~ 30 times the air discharge from the air gun 6.

[0015] Fig. 3 is a fragmentary sectional view schematically showing a part of the apparatus similar to the embodiment of the invention shown in Figs. 1 and 2. This apparatus 1 is similar to the apparatus shown in Figs. 1 and 2 except that the air gun 6 is replaced by sucker 33 placed in a laterally symmetric relationship about the fibers 16 as the means to blow the pressurized air against the fibers 16. A clearance R of each blow nozzle 34 in each of the suckers 33 is adjusted in a range of 0.1 ~ 1.0 mm so that a stretching ratio of the fibers 16 may be controlled in this range.

(EXAMPLE)

[0016] Polypropylene having a melt flow rate of 70 as measured in accordance with the prescription of JIS K 7210 was extruded and stretched to obtain continuous fibers and a nonwoven fabric formed with these continuous fibers using the apparatus of Fig. 3. Table 1 shows a relationship between conditions under which the continuous fibers are made and fineness (d).

(CONTROL 1)

[0017] Using polypropylene similarly to the EXAMPLE, the continuous fibers were obtained by the apparatus of Fig. 3 deprived of the hood and the nonwoven fabric was made from these continuous fibers. CONTROL 1 in Table 1 shows a relationship between conditions under which the continuous fibers are made and fineness.

(CONTROL 2)

[0018] Using polypropylene similarly to the EXAMPLE, the continuous fibers were obtained by the apparatus of Fig. 3 deprived of the suckers and the nonwoven fabric was made from these continuous fibers. CONTROL 2 in Table 1 shows a relationship between conditions under which the continuous fibers are made and fineness.

(CONTROL 3)

[0019] Using polypropylene similarly to the EXAMPLE, the continuous fibers were obtained by the apparatus of Fig. 3 in which the suckers were spaced apart from the duct by 30 mm and the nonwoven fabric was made from these continuous fibers. CONTROL 3 in Table 1 shows a relationship between conditions under which the continuous fibers are made and fineness.

(CONTROL 4)

[0020] Using polypropylene similarly to the EXAMPLE, the continuous fibers were obtained by the apparatus of Fig. 3 in which a suckers' air flow was adjusted to be 4.8 times a suction air flow and the nonwoven fabric was made from these continuous fibers. CONTROL 4 in Table 1 shows a relationship between conditions under which the continuous fibers are made and fineness.

[Table 1]

	EXAMPLE	CONTROL 1	CONTROL 2	CONTROL 3	CONTROL 4
Resin	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
Nozzle Discharge (g/min/hole)	1.0	1.0	1.0	1.0	1.0
Nozzle - Sucker Distance (mm)	1000	1000	-	1000	1000
	-	-	1000	-	-
Sucker Clearance (mm)	0.15	0.15	-	0.15	0.15
Sucker - Duct Distance (mm)	0	0	-	30	0
Duct Dimensions: A (mm)	7.0	7.0	7.0	7.0	7.0
C	300	300	300	300	300
Hood Dimensions: D	500	-	500	500	500
F	600	-	600	600	600
Sucker Air Flow ($Nm^3/min/m$)	9.3	9.3	-	9.3	9.3
Suction Air Flow ($Nm^3/min/m$)	133.3	133.3	133.3	133.3	45
Suction Air Flow to Sucker Air Flow (times)	14.3	14.3	-	14.3	4.8
Fineness (d)	0.97	1.59	1.89	1.19	1.60

[0021] As will be apparent from comparison of these examples with controls 1 - 4, the apparatus 1 according to this invention is able to obtain the continuous fibers having a fineness of 1 d or less and to make desired nonwoven fabric

from these continuous fibers.

[0022] The apparatus for making a nonwoven fabric according to this invention enables nonwoven fabric to be easily made from continuous fibers having a fineness of 1 d or less.

Claims

1. An apparatus for making a nonwoven fabric adapted to accumulate continuous fibers discharged from a plurality of spinning nozzles onto top surface of an air-permeable endless belt running in one direction under suction effect exerted from below said endless belt, wherein:

   between said nozzles and said endless belt, said apparatus comprises means adapted to blow pressurized air against said continuous fibers, a duct having a relatively small dimension as viewed in running direction of said endless belt and directly connected to said means so as to extend downward and a hood having a relatively large dimension as viewed in said running direction and directly connected to said duct so as to cover a vicinity of said endless belt's top surface so that an interior of said hood is subjected to said suction effect exerted through said endless belt from below said endless belt.

2. The apparatus according to Claim 1, wherein said means adapted to blow pressurized air comprise suckers or an air gun.

3. The apparatus according to Claim 1, wherein said continuous fibers are accelerated and stretched between said nozzles and said means as said continuous fibers pass through said duct and said continuous fibers accelerated in this manner are decelerated and dispersed in said running direction of the endless belt as well as transversely thereof.

4. The apparatus according to Claim 1, wherein an air flow of said suction is adjusted to be 8 ~ 30 times an air flow of said means for blowing of pressurized air.

5. The apparatus according to Claim 1, wherein a ratio of a dimension of said duct as measured in said running direction to a vertical dimension of said duct as measured in said direction from said nozzles toward said endless belt is in a range of 1 : 2.5 ~ 1 : 200.

6. The apparatus according to Claim 1, wherein a ratio of said vertical dimension of said duct as measured in said direction from said nozzles toward said endless belt to a dimension of said hood as measured in said running direction is in a range of 1 : 1 ~ 1: 1.5.

7. The apparatus according to Claim 1, wherein a ratio of said vertical dimension of said hood as measured in said direction from said nozzles toward said endless belt to said dimension of said hood as measured in said running direction is in a range of 1 : 1 ~ 1 : 1.3.

8. The apparatus according to Claim 1, wherein a clearance defined between said hood and said endless belt is normally closed by rollers adapted to move vertically of said endless belt as said rollers rotate in said running direction of said endless belt.

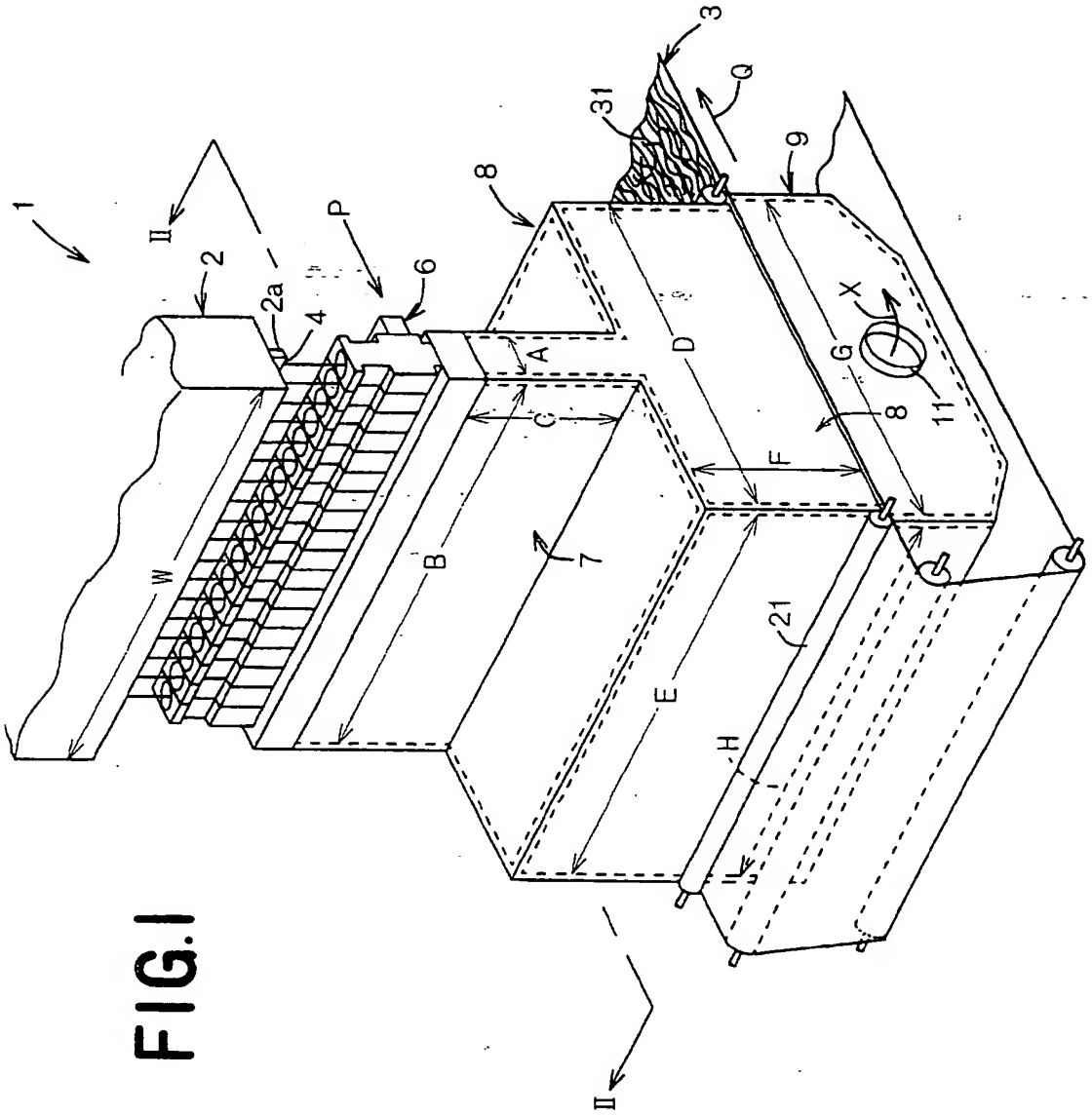


FIG.1

FIG.2

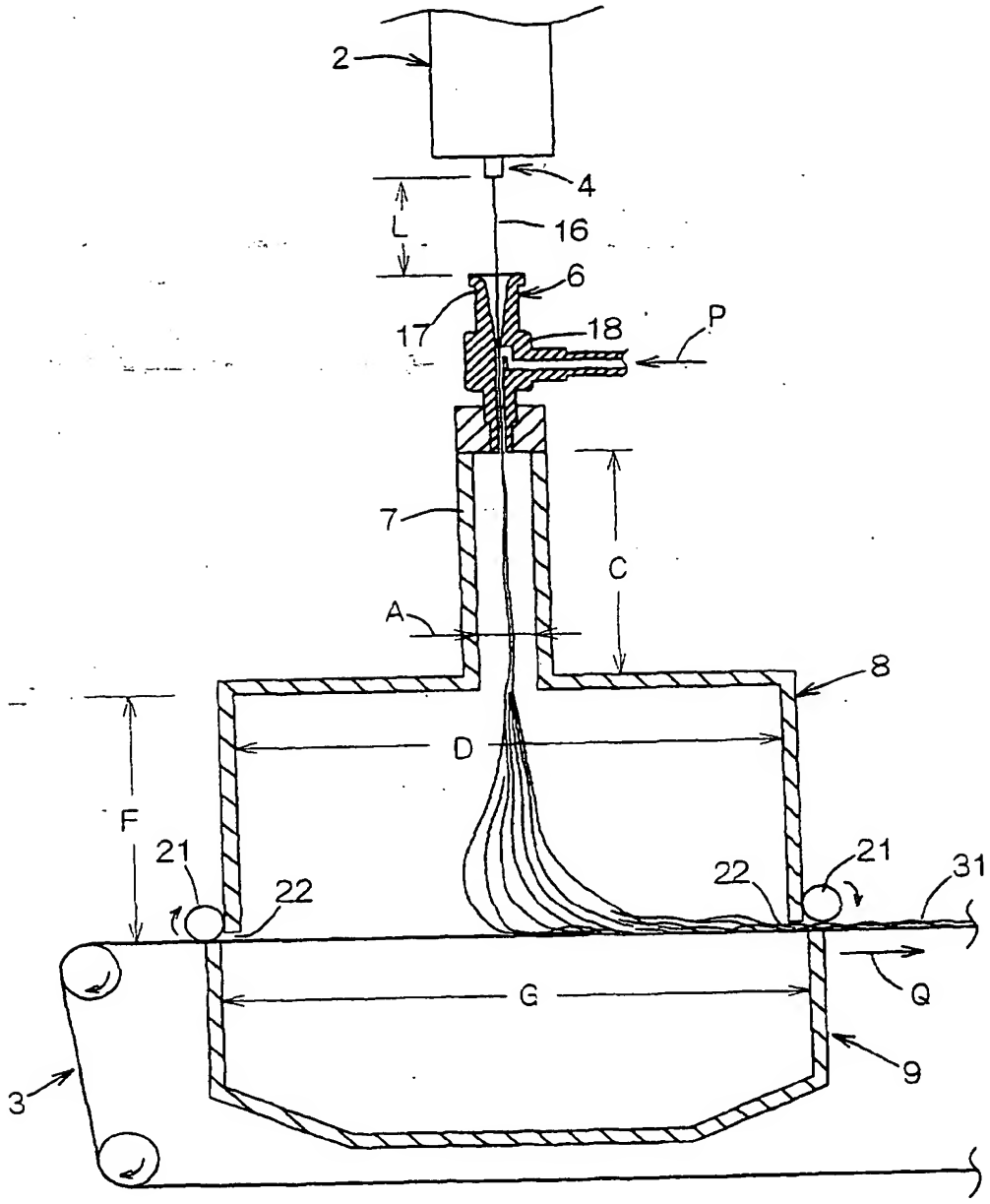
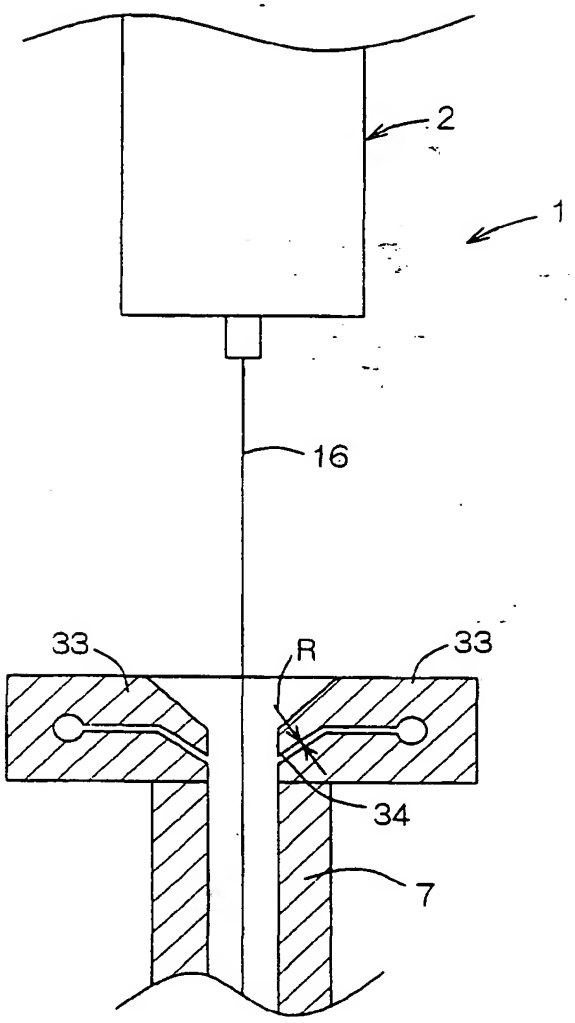


FIG.3



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EUROPEAN SEARCH REPORT

Application Number
EP 01 30 5737

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 627 811 A (GREISER WOLFGANG ET AL) 9 December 1986 (1986-12-09) * figure 2; example 1 *	1-8	D04H3/03 D04H3/16
X	US 5 766 646 A (FREY DETLEF ET AL) 16 June 1998 (1998-06-16) * figure 1 *	1-8	
X	US 5 460 500 A (GEUS HANS G ET AL) 24 October 1995 (1995-10-24) * figure 5 *	1-8	
A	US 4 818 466 A (KNITSCH GERHARD ET AL) 4 April 1989 (1989-04-04) * figures 1,2 *	1-8	
X	DE 21 63 795 A (METALLGESELLSCHAFT AG) 12 July 1973 (1973-07-12) * figure 1 *	1-8	
A	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 05, 31 May 1996 (1996-05-31) & JP 08 003852 A (KURARAY CO LTD), 9 January 1996 (1996-01-09) * abstract *	1-8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) D04H D01D
A	US 5 292 239 A (ZELDIN LEON M ET AL) 8 March 1994 (1994-03-08) * figure 1 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 October 2001	Barathe, R

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29-10-2001

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4627811	A	09-12-1986	DE	3401639 A1	25-07-1985
			EP	0150024 A2	31-07-1985
			JP	60155765 A	15-08-1985
US 5766646	A	16-06-1998	DE	19521466 A1	19-12-1996
			IT	MI960970 A1	14-11-1997
			JP	3135498 B2	13-02-2001
			JP	9095854 A	08-04-1997
US 5460500	A	24-10-1995	DE	4312419 A1	20-10-1994
			CA	2121383 A1	17-10-1994
			CN	1094463 A	02-11-1994
			IT	1273401 B	08-07-1997
			JP	2556953 B2	27-11-1996
			JP	7109657 A	25-04-1995
US 4818466	A	04-04-1989	DE	3541127 A1	27-05-1987
			AT	72681 T	15-03-1992
			DE	3683927 D1	26-03-1992
			EP	0224435 A2	03-06-1987
			ES	2031074 T3	01-12-1992
			JP	1577787 C	13-09-1990
			JP	2000463 B	08-01-1990
			JP	62206073 A	10-09-1987
DE 2163795	A	12-07-1973	DE	2163795 A1	12-07-1973
JP 08003852	A	09-01-1996	NONE		
US 5292239	A	08-03-1994	AU	4522993 A	30-12-1993
			CN	1090348 A	03-08-1994
			IL	105861 A	29-12-1994
			MX	9303283 A1	31-05-1994
			WO	9324693 A1	09-12-1993

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